Institute of Psychological Sciences
FACULTY OF MEDICINE AND HEALTH

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Influences on the development of food preferences in early life

Professor Marion M Hetherington

Aim

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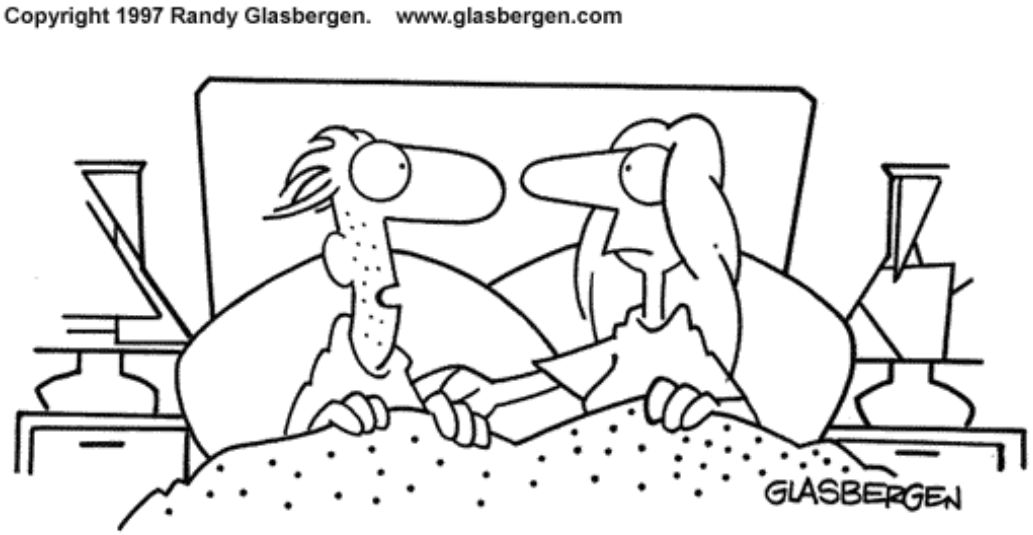
To provide an overview of early life eating habit formation

Set the scene – tackling the problem – future insights?



www.glasbergen.com

What is the problem?

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F&V **protect** against cancer, heart disease, type II diabetes, cognitive decline

Dietary phytochemicals such as phenolic acids, flavonoids, organosulfur compounds, and carotenoids have **antioxidant** and **tumour suppressant** effects

Citrus, green leafy, β-carotene- and vitamin C-rich F&V are associated with a **lower CHD risk** *(Bhupathiraju et al 2013);*

Vegetables **more protective** than fruit and benefits of 7+ portions per day noted *(Oyebode et al 2014, J Epid Comm Health)*

Quantity rather than variety of F&V linked to lower risk of CHD *(Bhupathiraju et al 2013)*

JECH Online First, published on March 31, 2014 as 10.1136/jech-2013-203500
Research report

OPEN ACCESS

Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data

Oyinlola Oyebode, Vanessa Gordon-Dseagu, Alice Walker, Jennifer S Mindell

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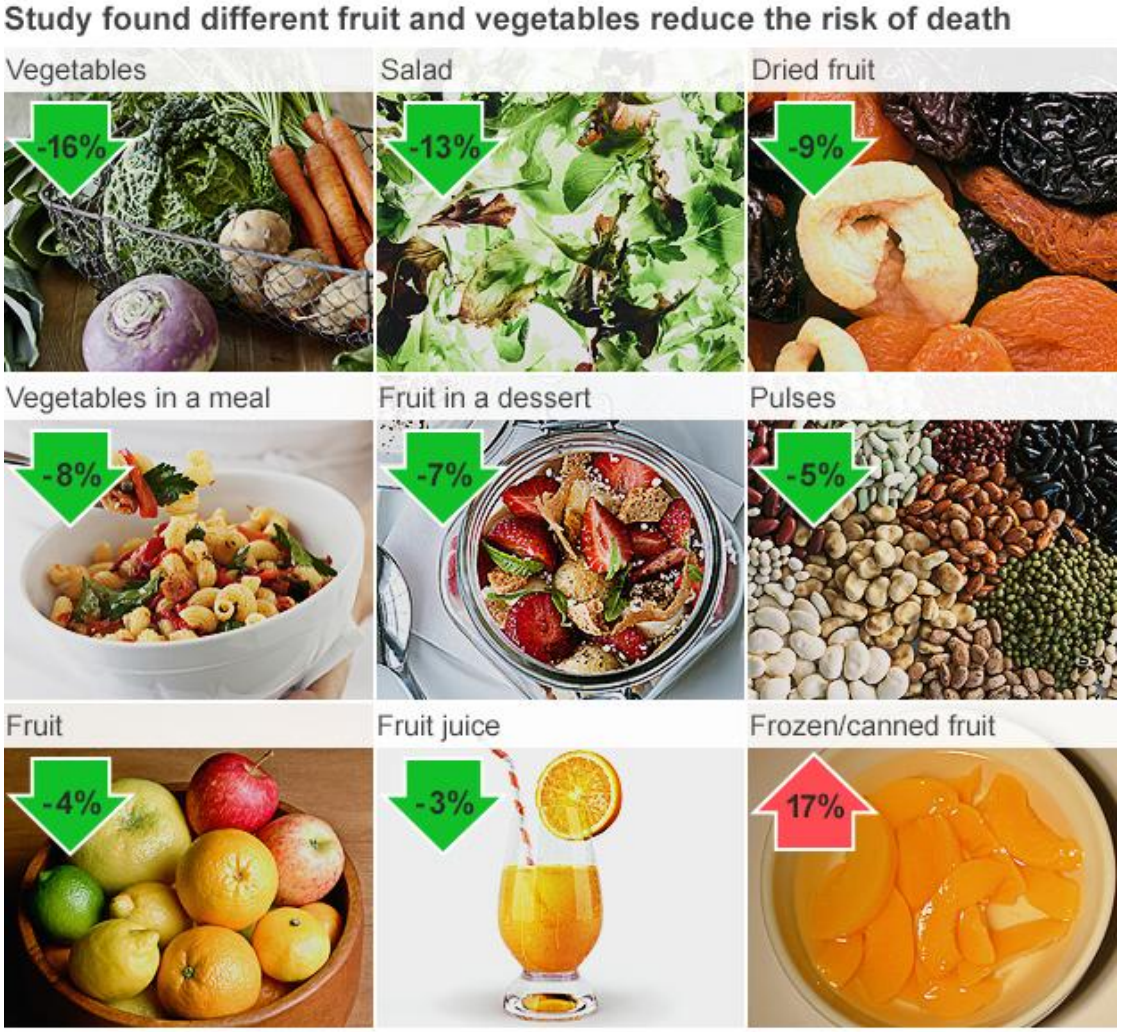
World Health Organisation has set a target of reducing non-communicable diseases such as obesity by **25%** by **2025**



What is the problem?

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FITS 2002, 2008

~ one third of US infants aged 9–23 m, did not consume any fruit, in any amount, on the day of the survey in 2002 (24-35%) and this changed very little in 2008 (16–27%)

European children eat **fewer** vegetables than is recommended *(Currie et al, 2004)*

Early eating habits **track** throughout life *(Devine et al., 1998; Nicklaus, et al., 2004, 2005; Skinner et al, 2002)*

Early origins
Infancy as a critical period

Learning to like vegetables – at school
Too late to learn?

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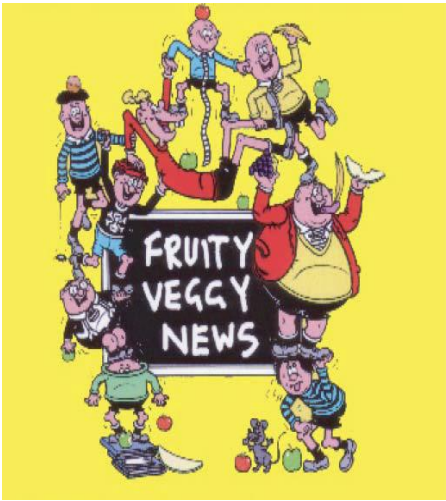
21 studies entered into a ***meta-analysis***

Improvement of ***0.25*** portions of daily fruit and vegetable intake (excluding fruit juice)

Intake of fruit increased by ***0.24*** portions

Intake of vegetables increased by **0.07** portions

Interventions ***selectively*** improve fruit not vegetable intake



Evans et al (2012) AJCN

univore

learning/
experience

innate
capacities

omnivore

Neonatal response to taste

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rest **water** ***sweet*** ***sour*** ***bitter***

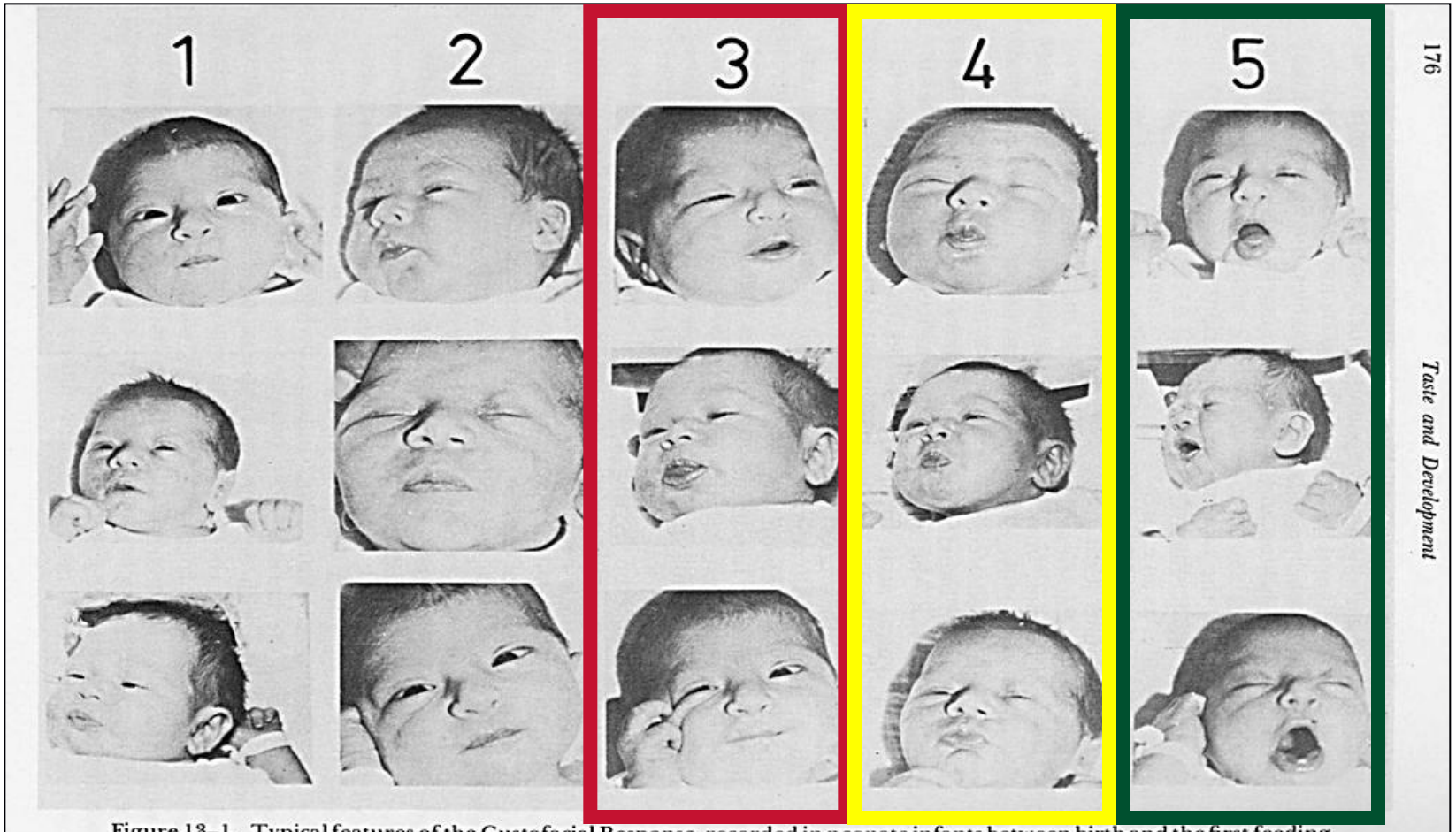

Figure 13–1. Typical features of the Gustofacial Response, recorded in neonate infants between birth and the first feeding. 1: Resting face. 2: Reaction to distilled water (control). 3: Response to sweet stimulus. 4: Lip-pursing, response to sour stimulus. 5: Response to bitter stimulus.

STEINER, 1977

Sweet is ***accepted***

Foods which are sweet are easily accepted (liked and eaten)

Bitter is ***rejected***

Foods such as vegetables are less easily accepted (disliked and avoided)

Universal Hedonic Reaction:
Tongue Protrusions to Sweet

Universal Aversion: Gapes to Bitter

Sensitive periods in taste development

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According to Harris (1993):

- **4–6** m infants are **willing** to taste all new foods
- **6–12** m is a **sensitive** period for solid textures
- **12–18** m children **recognise** foods by appearance
- **18–24** m children become **neophobic**

Images from Forestell and Mennella (2007) Pediatrics

Early development

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- Foetus can swallow, so **transfer** of maternal dietary components is possible in amniotic fluid
- Exposure to **taste**?
- Can **maternal diet** influence food choice later in life?

Pre-natal flavour exposure

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- 10 pregnant women
- 45 min prior to **amniocentesis**
- 5 ingested **garlic** capsules; 5 had **flavourless** capsules

sensory panel judged odour of amniotic fluid as ***stronger*** following garlic compared to controls

Image: JM Loomis

Mennella et al. (1995)

Odour preference

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•infants 15 - 24 hr after birth **orient** towards garlic odour if mothers typically consume garlic in the diet (Hepper,1995)

• newborn babies **prefer** anise odour if mothers consume anise in the diet (e.g. fennel) during pregnancy (Schaal et al., 2000)

Marlier & Schaal (2005) Child Development

• new born babies **prefer** human **breast milk** more than formula milk (Marlier & Schaal, 2005); **even** if they are formula fed!

Odour preference

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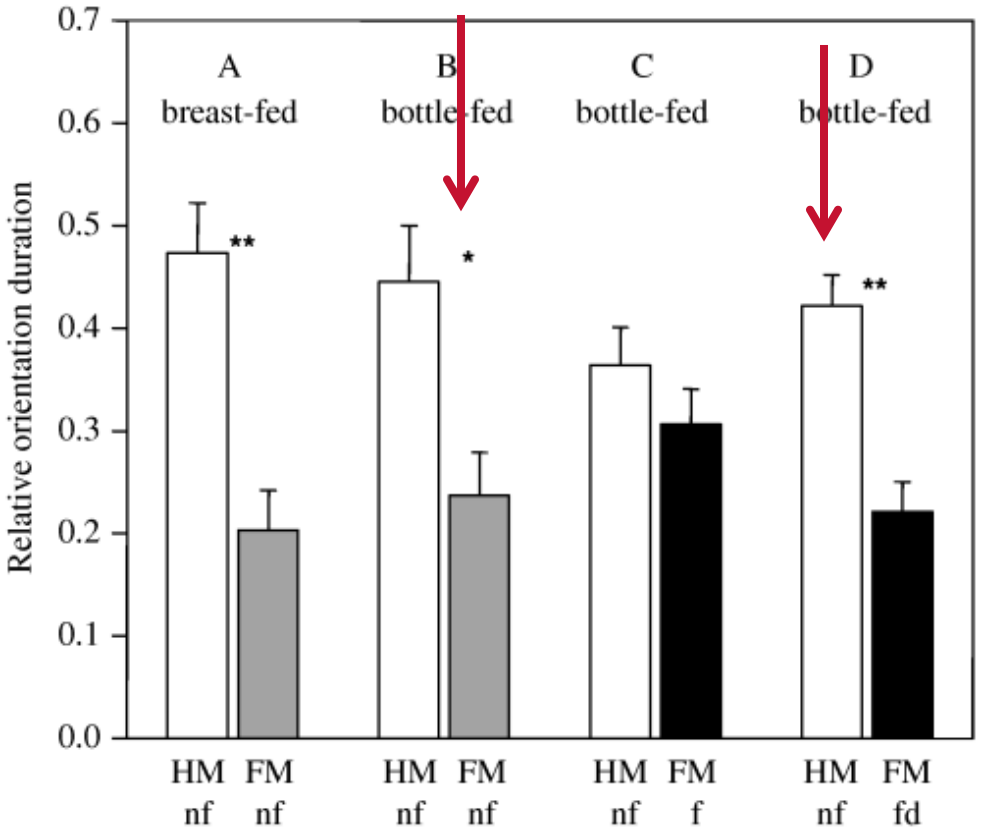
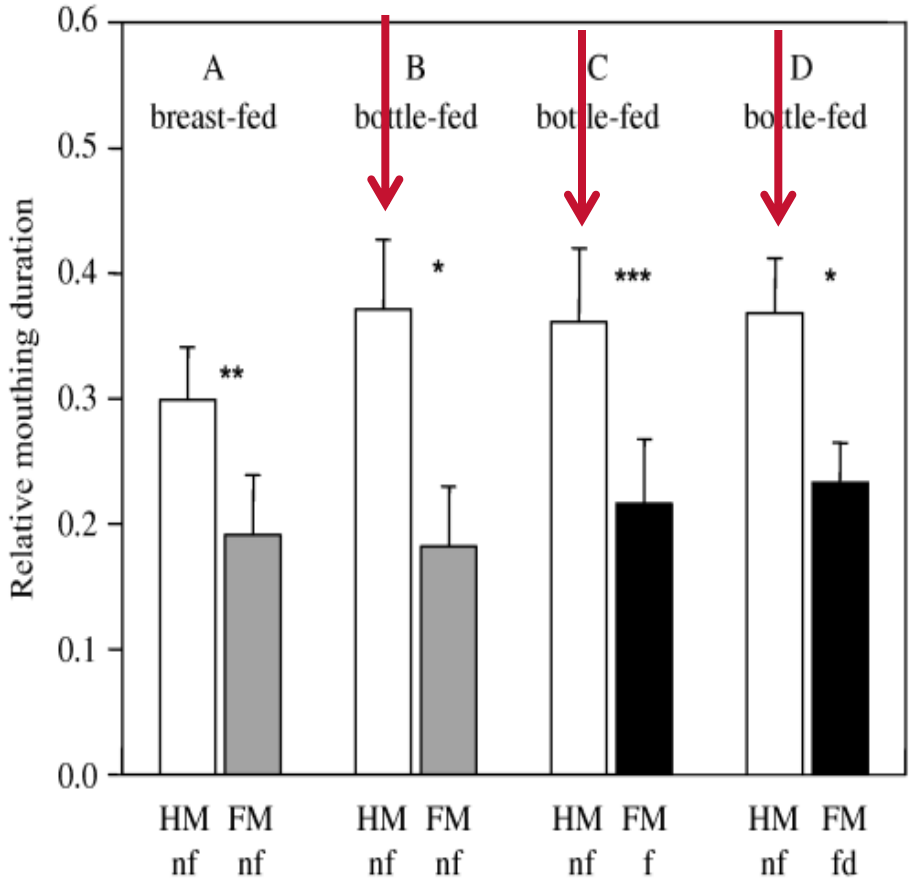


Mean relative duration (±*SEM*) of head orientation in 4d old newborns simultaneously exposed to the odors of human milk (HM) and formula milk (FM); f=familiar; nf=nonfamiliar; d=diluted stimulus. $^{*}p<.05$. $^{**}p<.01$.



Mean relative duration (±*SEM*) of oral activation of 4-day-old newborns simultaneously exposed to human milk (HM) and formula milk (FM) odours $^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$.

Marlier & Schaal (2005) Child Development

Pre- and postnatal flavour learning

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Do infants learn to prefer flavours they have been exposed to *in utero?* Is there evidence of *chemical continuity*?

3 groups pregnant women:

300 ml carrot juice or water 4d/wk during 3 consecutive weeks in final trimester

CW = drank **carrot juice** during **pregnancy** then had water

WC = drank water during pregnancy then **carrot juice** during **lactation**

WW = drank ***water*** during pregnancy then ***water*** during lactation

Infants offered **weaning cereals** flavoured with **carrot juice**

Mennella et al. (2001) Pediatrics

Pre- and postnatal flavour learning

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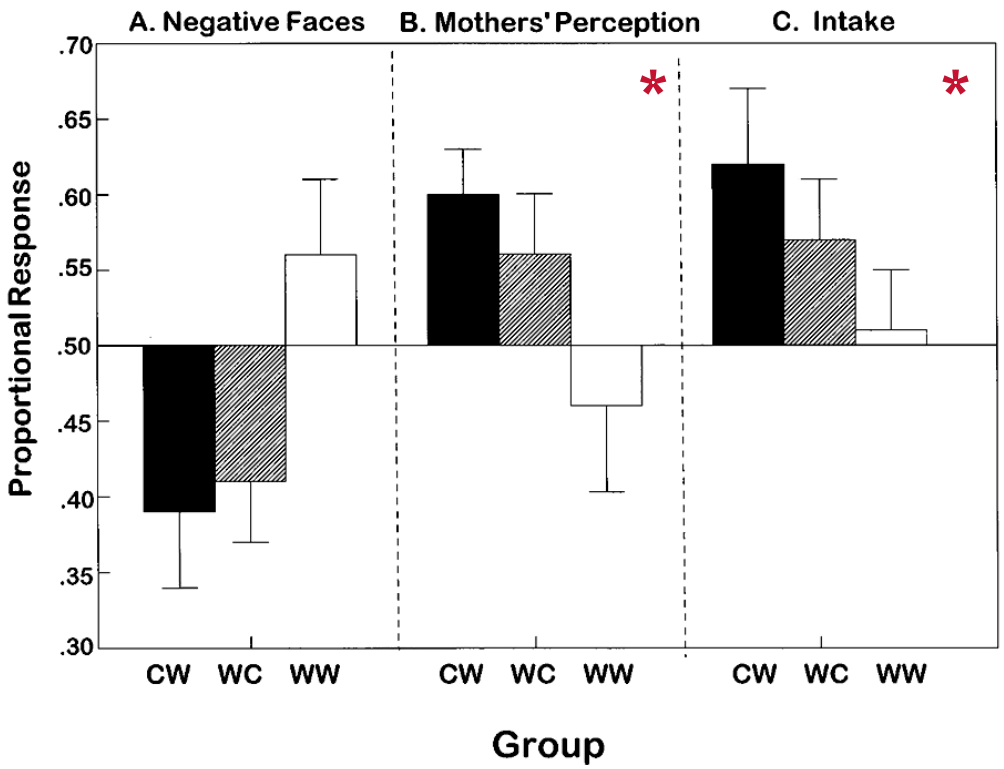

* $p < 0.05$

Chemical continuity?

Exposure to carrot juice ***either*** in pregnancy or lactation increased preference for the cereal with carrot juice > controls

Mennella et al (2001) Pediatrics

Breastfeeding promotes acceptance

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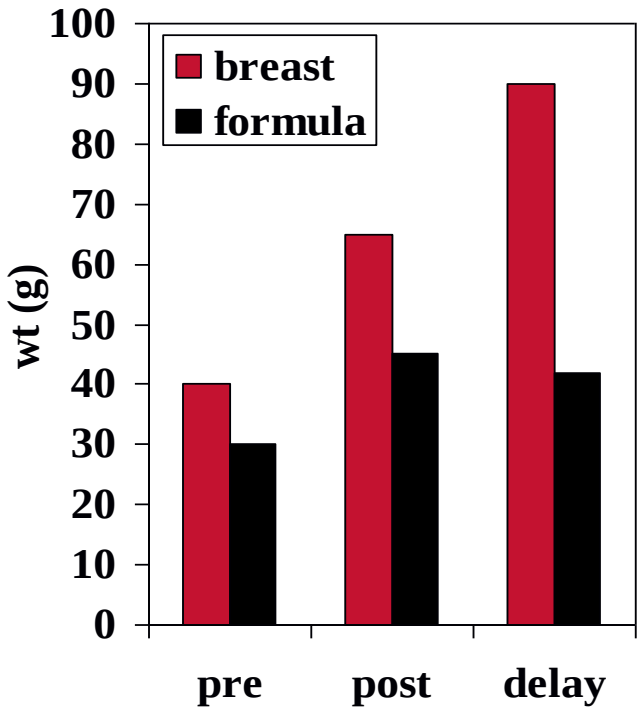
Studies have shown that BF babies are more willing to accept novel flavours including vegetables (Sullivan & Birch 1994)

Formula fed babies are more likely to reject new foods even at 12m (see Paul et al., 2011 Obesity).



Offered salted or unsalted peas or green beans each day for 10 d; then re-tested after a delay of 1 wk.

Breast fed infants (n = 19):

- **consumed** more novel vegetable
- more willing to **accept** new flavours than bottle fed infants (n = 17)

Sullivan & Birch (1994) Pediatrics

« Donner les bases du goût »

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French mothers (n = 18, 25–39 years) from Lyon and Dijon

Themes from focus groups and interviews:

Weaning as a critical milestone for infants' development, a sense of ''**now or never**''

Flavour exposure including vegetables was part of the ''**taste journey**"

To "**educate the palate**" variety was considered important to shape later eating habits

Water from cooking vegetables or pureed vegetables added to milk at the time of complementary feeding assists the "foundation of taste"

Appetite 71 (2013) 321–331

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Complementary feeding and "*donner les bases du goût*" (*providing the foundation of taste*). A qualitative approach to understand weaning practices, attitudes and experiences by French mothers ☆

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Vegetables at weaning

UNIVERSITY OF Viva EATING A RAINBOW

Inspired by the research on breastfeeding and by the practices of French mothers:

Intervention developed to test the hypothesis that early, varied and repeated exposure to the taste of vegetables would enhance their acceptance at weaning.


WELCOME TO

ID Number

Viva
EATING A RAINBOW

Weaning trial
version 31/10/2011 - ethics #11-0031

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Methods - participants

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40 mothers were randomised to intervention or control group; 36 mother-infant dyads completed the study

Mothers	Maternal age (years)	Maternal BMI (kg/m^2)	Primiparous	Maternal education <Uni	Maternal education Uni +
control n=18	30.88 ± 4.4	26.01 ± 7.7	13 (72.2%)	7 (38.9%)	11 (61.1%)
intervention n=17	33.65 ± 5.4	24.69 ± 5.1	8 (47.1%)	8 (47.1%)	9 (52.9%)

	Gender		Milk Feed		Age on D1 (m)	Weight initial visit (kg)	Length initial visit (cm)
Infants	**male**	**female**	**BM (or mixed)**	**FM**			
control N=18	8	10	6	12	4.9	7.6	65.3
intervention N=18	8	10	6	12	4.8	7.3	65.1

Vegetables at weaning

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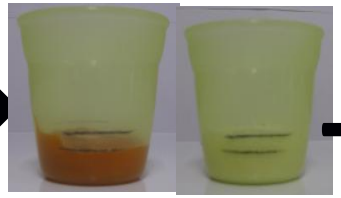
Carrot

Green beans

Spinach

Broccoli

Parsnip



Vegetable purees + milk

40% by weight in breast milk or infant formula

Vegetables at weaning

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- Flavoured Baby Rice (70% veg)

Vegetable purees + cereal

- Plain Baby Rice

Sensory evaluations

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Product

Baby rice

Product

Almirón

Scale: 9-point-scale with labels:

- How strong is the *intensity of the vegetable flavour*?
- How much do you *like the sample*?

Extremely weak								Extremely strong
Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely

Vegetables at weaning - design

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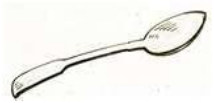


Day Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Phase	Milk: 12 days											X1 a day	Baby Rice: 12 days											X2 a day	Purees: 11 days										X1 a day
Control Group	Plain milk: usual quantity												Plain Baby Rice : max~77g												Vegetable puree : max~260g										
																									Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Pa
Intervention Group	Flavoured milk : max ~50g												Flavoured Baby Rice : max~72g												Vegetable puree : max~260g										
	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Sp	Br	Ca	GB	Pa



Intervention- received vegetables on a daily rotation and twice per day for cereal

De-brief after D35 then follow up at 6m, 18m and 24m

Measurements

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Weighed intake during laboratory sessions

Mothers fed their baby and were told to stop when they had observed 3 consecutive refusals

Mothers were given **training** in how to identify refusals

- **Liking** was reported by mother, researcher and an independent rater
- **Facial and behavioural responses** were filmed and coded by independent raters
- **Intake** was reported at home in diaries

Relationship between coding, liking and intake

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Variables	Intake	Maternal Rating	Researcher Rating
Turns head away (THA)	**-0.59****	**-0.40***	**-0.46****
Arches back (AB)	**-0.40***	-0.19	-0.22
Leans forward (LF)	0.27	0.29	0.22
Rate of acceptance (ROA)	**0.72****	**0.62****	**0.67****

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EATING A RAINBOW

Vegetable intake

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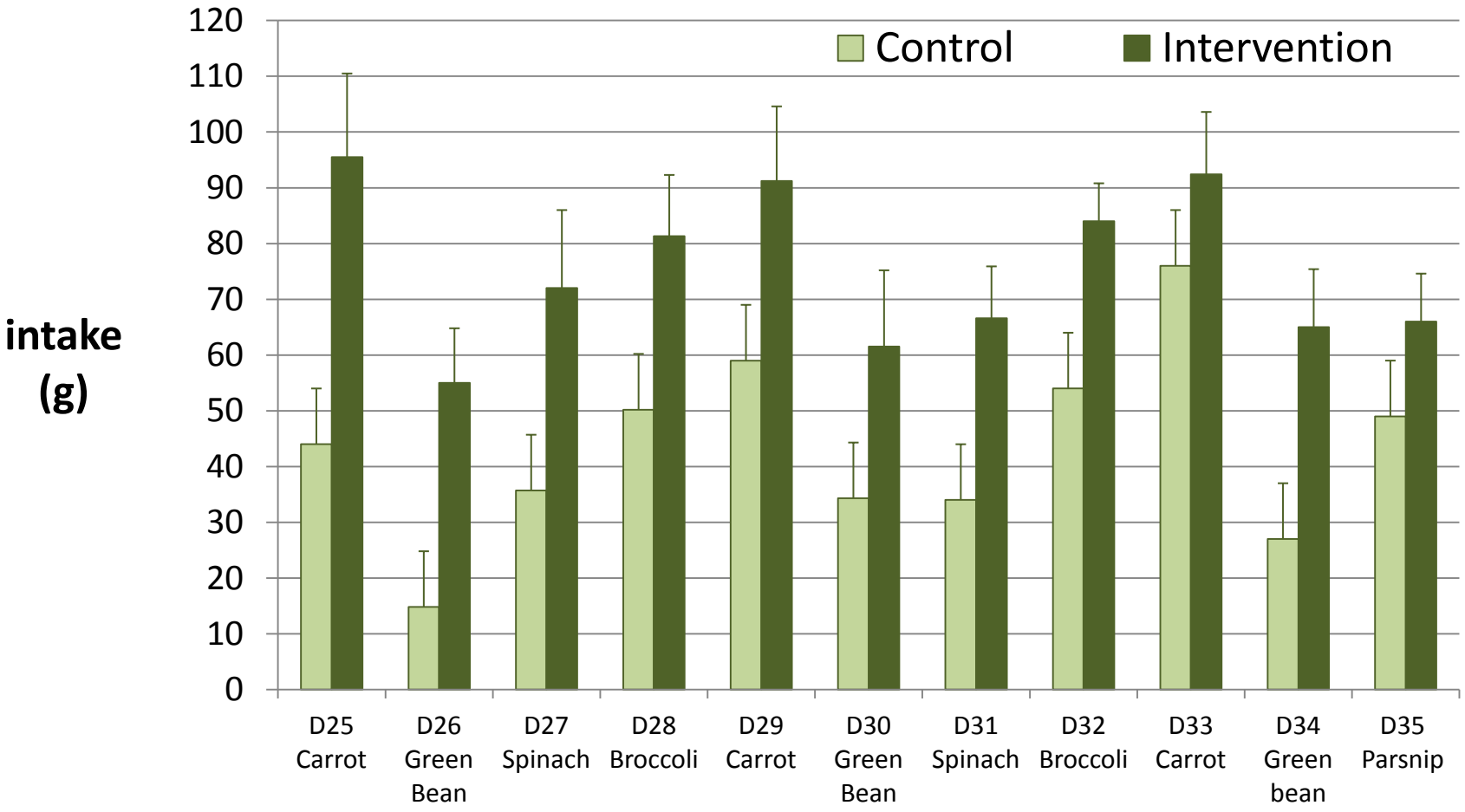

Main effect of Group: I > C (81.7 ± 9g vs 44.13 ± 8g)
Main effect of Time: intake increased over time (55 ± 6g to 70.8 ± 8g)
Main effect of Vegetable: carrot (83.1 ± 9g) > green bean (42.7 ± 5g).

Rate of eating

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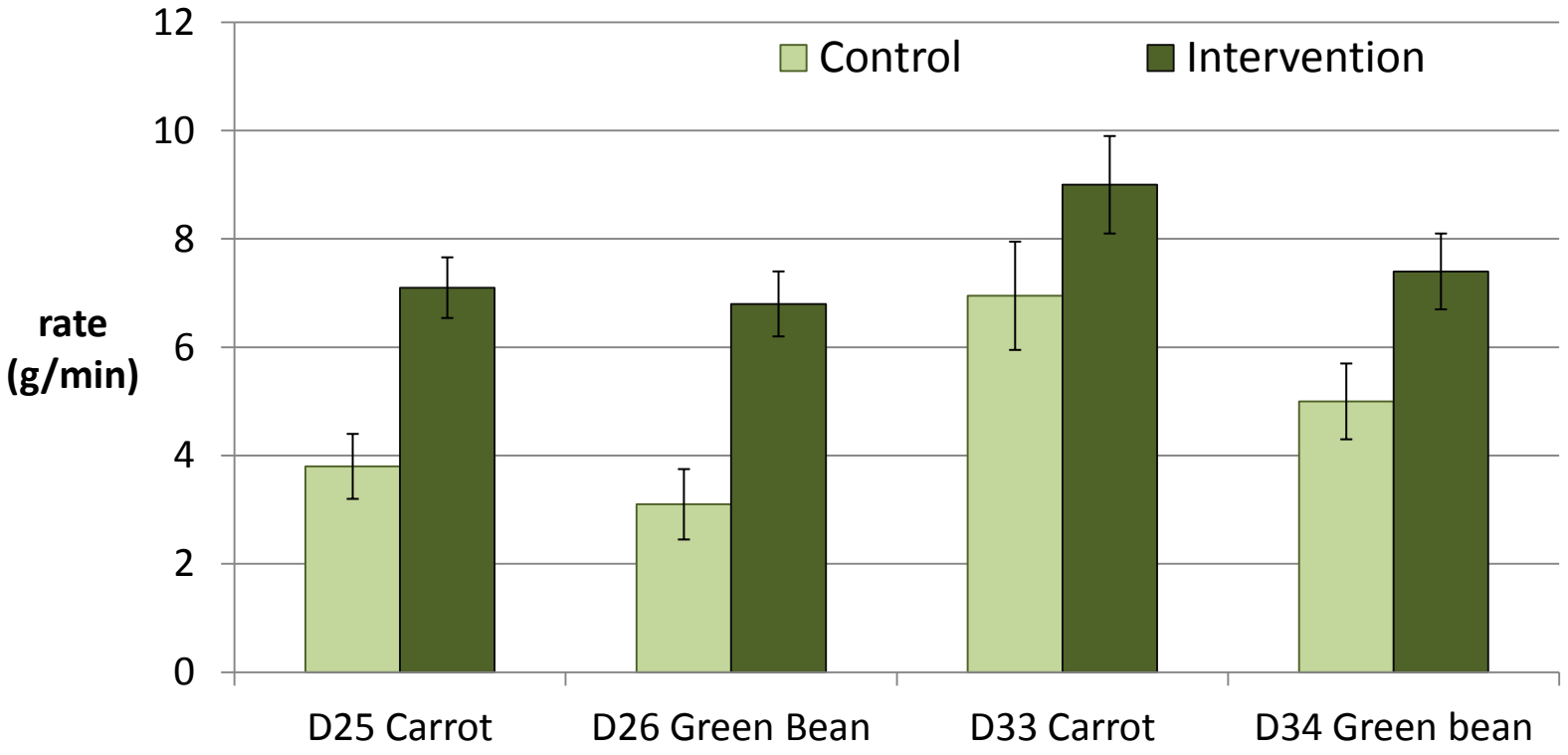

Main effect of Group: I> C - 7.5 ± 0.6g/min vs 4.7 ± 0.55g/min
Main effect of Time: increased rate over time from 5.2 ± 0.4g/min to 7 ± 0.55g/min
Main effect of Vegetable: 6.7 ± 0.55g/min for carrot vs 5.5 ± 0.4g/min for green bean

Ratings of liking

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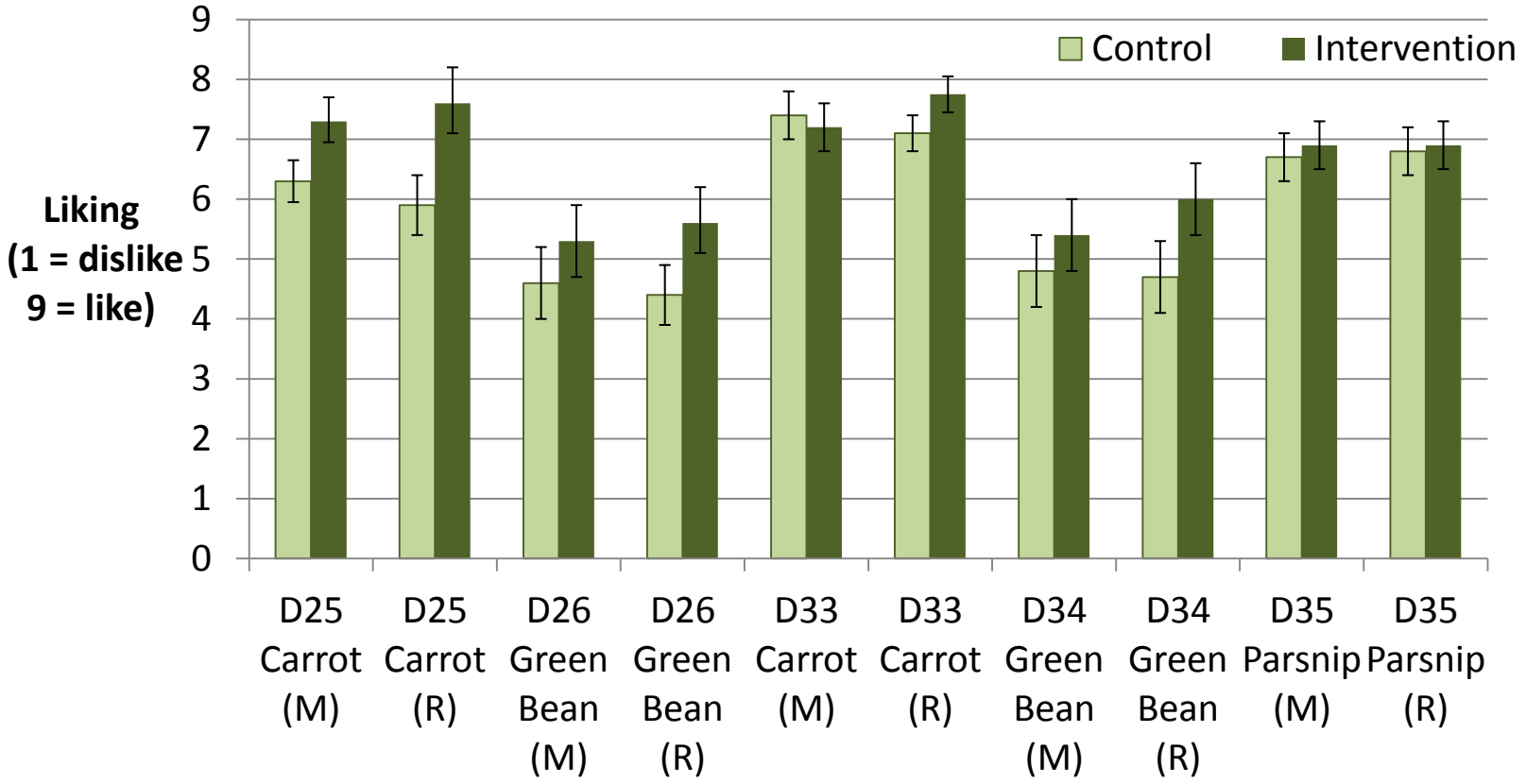

Main effect of group – only significant for researcher (R) not mother (m)
Main effect of time – only marginally significant for researcher
Main effect of vegetable – significant for both researchers and mothers
Carrots > Green bean (7.0 ± 0.3 vs 5.1 ± 0.3) across group and time

Summary

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Healthy eating starts early in life

Breastfeeding confers many benefits to infants

Early and repeated **exposure** to healthy foods such as vegetables promotes their intake

Mothers may misinterpret signals from infants, facial expressions may not mean disgust or dislike just surprise!

Acknowledgements

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VIVA project **EU FP7 Marie Curie IAPP 230637; RCN 90766**
"VIVA: V is for Vegetable – Applying Learning theory to increase liking and intake of vegetables'